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Nevada Division of Environmental Protection
Bureau of Federal Facilities
333 W. Nye Lane
Carson City, Nevada 89706-0851

December 20, 1999

Ms. Runore C. Wycoff, Director
Environmental Restoration Division
U.S. Department of Energy
Nevada Operations Office
P.O. Box 98518
Las Vegas, Nevada 89193-8518

RE: Review of Corrective Action Investigation Plan, Revision 1
Corrective Action Units 101 and 102: Western and Central Pahute Mesa
Nevada Test Site, Nevada
Federal Facility Agreement and Consent Order

Dear Ms. Wycoff:

The Final Corrective Action Investigation Plan (Revision 1) for Corrective Action Units (CAU) 101 and 102: Central and Western Pahute Mesa, Nevada Test Site, Nevada, has been reviewed by the Nevada Division of Environmental Protection (NDEP) staff. This Corrective Action Investigation Plan, Revision 1 (CAIP-PMR1), is hereby approved with comments, pursuant to Subpart XII.8.a of the Federal Facility Agreement and Consent Order (FFACO).

The Department of Energy must address the following comments in subsequent documents prepared in conjunction with the investigation. Failure to address the comments will cause NDEP to construe the subsequent milestone document(s) as Substantially Deficient pursuant to Subpart VIII.3.b of the FFACO. As a general note, proposed extensions of future deadlines must be applied for in accordance with Subpart X of the FFACO.

If the proposed remedial alternative in the subsequent Corrective Action Decision Document (CADD) for this CAU is not clean closure, then, following a review and preliminary determination of the appropriateness of the proposed action by NDEP, it will be necessary to present the proposed alternative to the Community Advisory Board by way of satisfying the requirement for public notice of a proposed action prior to formal approval of the document and recommended action by NDEP.

For CAUs not located on or extending off of the Nevada Test Site (NTS) and when the recommended alternative is not clean closure, the Corrective Action Decision Document (CADD) must state that the agency which is ultimately responsible for managing the land on which the CAU is located has accepted the proposed action including the need for Land Use Restrictions (LURs). Certification that the LURs have been entered in the appropriate tracking system must be provided in the subsequent Closure Report.

The Corrective Action Investigation Plan for Corrective Action Units 101 and 102: Central And Western Pahute Mesa, Nevada Test Site, Nevada, Revision No. 1, September 1999 (document), was received by the Nevada Division of Environmental Protection (NDEP) on 09/28/99. Prior to receiving this document, NDEP had received, reviewed, and provided comments on three earlier versions listed below:

1) Corrective Action Investigation Plan
   For Corrective Action Units 101 and 102:
   Central and Western Pahute Mesa, Preliminary, Revision No.1,
   March 1999

2) Corrective Action Investigation Plan
   For Corrective Action Units 101 and 102:
   Central and Western Pahute Mesa, Revision, No. 0, September 1998

3) Corrective Action Investigation Plan
   For Corrective Action Units 101 and 102:
   Central and Western Pahute Mesa, Draft, Revision No. 0, May 1998

NDEP recognizes that as characterization/field work activities proceed, additional investigations may be required or justified based on information developed in the course of the ongoing work.

GENERAL COMMENTS

General Comment No. 1: Data Quality Objectives, the 10 Step Model Validation Process, and the Adequacy of Data

The Corrective Action Investigation Plan for Corrective Action Units 101 and 102: Central and Western Pahute Mesa, Nevada Test Site, Nevada, Revision 1 (CAIP-PMR1) provides for the collection of additional data. NDEP is concerned, that even with the collection of the presently identified data needs, there still may not be sufficient information to achieve the goals and objectives of the Corrective Action Investigation (CAI).

Inherent in the Data Quality Objective Process, the computer model validation process, and UGTA Technical Strategy is the requirement that

data, for any phase, be evaluated and a determination be made that the accumulated data are sufficient to proceed to the next phase in the CAI. NDEP cannot determine from the CAIP-PMR1 what criteria DOE will utilize to make decisions on data sufficiency.

A. Adequacy of Data

There are multiple areas in which NDEP perceives potential problems with the adequacy of the present data collection efforts. Limited data will impact the accuracy, confidence, reliability, and acceptance of all work performed under this CAIP. Of particular concern is the limited number of Corrective Action Sites (CAS) with site-specific hydrologic parameter data. The areas where there is a lack of data which concerns NDEP includes, but is not limited to, the following:

- The limited number of drill holes and monitoring wells relative to the size of the CAU study area;

- Lack of hydrologic characterization - Only two sites have had hydrologic aquifer testing and both of these sites are within the Western Pahute Mesa CAU. There is extremely limited hydrologic parameter testing in the Central Pahute Mesa CAU. Hydrologic parameter data are planned to be collected from the Pahute Mesa/Oasis Valley wells, however, these data will not be from locations near the CASs and no site-specific data from the near-field environment will be collected from Pahute Mesa;

- Hydraulic Conductivity - One of the essential missing data elements is the hydraulic conductivity tensor at each location for which a matrix of data are being presented. This, and related statements to the effect that saturated hydraulic conductivity decreases exponentially with depth below land surface, are deficiencies to be remedied;

- CAU-Specific Diffusivity/Dispersivity Data - The CAIP-PMR1 does not set forth CAU-specific diffusivity or dispersivity data. (Model input parameters derived from

assumed probability distribution functions (pdfs) are not to be equated with actual CAU-specific field or laboratory data. Note also that the term "CAU-specific" means in and on the boundaries of CAUs 101 and 102 as they currently exist.) This lack of CAU-specific information is a deficiency to be remedied;

- Near-Field Radionuclide Source Term - The radionuclide source term information appears to be insufficient. Only a few sites have been demonstrated by the CAIP-PMR1 to have any source term information. At the Schooner event site, work was initiated to determine the significance of radionuclide contamination in Well PM-2, however the study at this site has not been completed;

Additional issues regarding the deficiency in data are identified in the specific comments attached to this letter.

B. Data Adequacy Requirements

A major task is to determine whether adequate and sufficient data exist to proceed through the CAI process to reach the goal of developing an acceptable model.

In removing the determination of Substantial Deficiency from the original submittal of the PM- CAIP related to model validation, it was agreed that the 10-step model validation process would be followed as a refinement of the UGTA Technical Strategy. This series of steps which, when followed, builds support in demonstrating that a given site-specific model is capable of producing meaningful results, does intuitively require determinations of data adequacy to achieve the model purposes. As previously stated, NDEP cannot determine from the CAIP-PMR1, how DOE will evaluate the adequacy of data enabling progression from one step to the next.

<u>10-Step Method for Model Validation</u>

1) Establishing the model purpose
2) Developing a sound conceptual model

3) Selecting a computer code that is appropriate for the system being modeled, followed by verification that the code fulfills all predefined requirements
4) Designing the model in a manner which follows accepted modeling practice
5) Calibrating the model with an acceptable degree of variance to site-specific conditions
6) Performing sensitivity and uncertainty analyses to quantify and assess model performance
7) Verifying the representativeness and uniqueness of the model against an independent set of site-specific data
8) Running predictive simulations that are in accordance with the objectives of the modeling exercise
9) Presenting clear and complete documentation of the modeling results
10) Performing a postaudit as part of a proof-of-concept undertaking

C. Plan for Evaluating Data Adequacy and Needs

Within 90 days of the date of this letter, DOE must provide to NDEP its criteria and methodologies for the evaluation of current and future data. DOE must identify whether it plans on using professional judgment, computer modeling, other techniques for data evaluation, or a combination of these techniques. This submittal must also discuss at what level of confidence in the data DOE will move forward in the CAIP process to begin the primary modeling activities which will meet the goals of the CAIP.

All data deficiencies including those identified by NDEP general and specific comments, must be addressed as addenda to the CAIP-PMR1, in work plans, or in specific data collection and analysis plans.

General Comment No. 2: **NDEP Review of Processes, Documentation, and Reports**.

According to the CAIP-PMR1, DOE is committed to involving NDEP at critical times in the data collection/reduction and modeling process, however, the data documentation is only planned to be delivered and reviewed after a certain stage of modeling has been completed. Since the data collection, reduction, and assessment is expected to be an iterative process, the data documentation should be developed and assembled during this process. The data documentation developed and/or revised and updated after each iterative step is required to be submitted to NDEP.

General Comment No. 3: Conceptual Model

The conceptual model of groundwater flow away from the CAUs and down gradient to potential receptors, as presented in the CAIP-PMR1, continues to cause concern. The section of the text illustrating release and discharge mechanisms is acceptable, however, the groundwater flow path portion simply revisits the regional model results. What is not clear is the current interpretation, presented in a conceptual framework, of how a drop of contaminated water will move away from the site. Which hydrostratigraphic unit does it move through? What direction (horizontally and vertically) will it migrate? Is flow predominantly through porous media or in fractures? Do faults play an important role in groundwater flow across the site? What is the current understanding of recharge areas, discharge areas and boundary conditions? These questions refer to significant elements of the conceptual model which are absent from the CAIP. The idea of presenting multiple conceptual models (in effect multiple working hypotheses) is one that has merit and could have been attempted here. The flow system, as it is currently understood, should be presented in concept before a serious modeling effort is undertaken

General Comment No. 4: Regional Model

Questions remain concerning the manner in which the regional model will be used for generating input boundary conditions. The same rather cumbersome technique was utilized in the Frenchman Flat work. It may be that this is the most practical way of incorporating technically defensible boundary conditions into the model and establishing some consistency between regional and CAU-specific representations of the flow system. DOE must be able to clearly correlate these bounding conditions with CAU specific data.

Not mentioned in the CAIP-PMR1 is the recent work undertaken by the USGS to merge the Yucca Mountain Project regional model with the UGTA regional model to form the Death Valley Regional Model. The new merged model may supply newer and more defensible boundary conditions and NDEP will refer to the USGS work in its review of the CAU-scale model.

General Comment No. 5: Study Area and Model Size

The areal extent of the study area and the CAU model area are still too large. For developing an understanding of the currently impacted area and magnitude of the contamination, sub-CAU site modeling may be needed. (A similar issue was identified by the Peer Review Panel in the draft Frenchman Flat modeling report.) Therefore, in addition to the CAU-scale model, additional smaller-scale models may be appropriate.

Since the CASs are numerous and spread across a wide area, representative events or subareas (containing multiple events) should be selected for these smaller scale evaluations. This would include sites in both the Central Pahute Mesa CAU and the Western Pahute Mesa CAU. DOE must evaluate the need for smaller-scale models and analysis.

General Comment No. 6: CAIP-PMR1 Milestones

A requirement of the FFACO is that the DOE provide time frames for the various iterative steps of the Corrective Action Investigations. The CAIP-PMR1 fails to acceptably provide these time frames. **Therefore, within 60 days of the date of the letter, DOE must provide a schedule with proposed time frames for each phase of the Pahute Mesa Corrective Action Investigation work. This needs to include the proposed dates for completion of the multiple data collection activities outlined in this CAIP with start and completion dates for modeling. The total schedule must be consistent with, and bound by, the Deadline date for the completion of the Correction Action Decision Document.**

Questions regarding this matter may be addressed to C. Goewert at (702) 486-2865, C. Case at (775) 687-4670 Ex. 3029, S. Jaunarajs at (775) 687-4670 Ex. 3030 or P. Liebendorfer at (775) 687-4670 Ex. 3039.

Sincerely,

Paul J. Liebendorfer, P.E.
Chief
Bureau of Federal Facilities

PJL/SJ/CJG/CC/js
Enclosure

cc: w/enclosure
Dave Bedsun, DTRA
Ken Hoar, DOE/EPD

Patti Hall, DOE/ERD
Frank Di Sanza, DOE/MWD
Robert Bangerter, DOE/ERD
Karen K. Beckley, NDEP/CC
Jeff Johnson, NDEP/CC
Mike McKinnon, NDEP/LV
Earle Dixon, CAB Technical Advisor
Bob Loux, NWPO

SPECIFIC COMMENTS

The following are NDEP's Specific Comments regarding the CAIP-PMR1 (document).

Specific Comment No. 1: Insufficient PM CAU-Specific Hydraulic Conductivity Data

An issue raised in the Peer Review Panel's comments on the Frenchman Flat Preliminary Draft Flow and Transport Modeling report and in NDEP'S comments on the Frenchman Flat CAIP and the Pahute Mesa CAIP Rev.0 is the need for CAU-specific measurements of hydraulic conductivity. DOE proposes to estimate the hydraulic conductivity values in part by an exponential decrease of hydraulic conductivity values with depth. This method has no basis and is unsupported by data. Hydraulic conductivity values should be measured in and on the boundaries of the PM CAUs to give better overall estimates.

<u>Specific Comment No. 2</u>: **"Calibrated" Values of PM CAU-Specific Hydraulic Conductivity Unsuitable for Required Deterministic Model Validation Predictions**

On p. 170 of the document the statements are made that *"Hydraulic conductivity values have been measured in numerous wells in and around the Nevada Test Site (IT, 1996d) . . . First, the range of measured values provides an uncertainty range within which the calibrated values should fall. Second, the values will be used during the uncertainty analyses to generate realizations that are as realistic as possible . . . Measured conductivity within the zones (which are not yet defined) will be used to bound the range of values.*

During the uncertainty analyses, a number of possible hydraulic conductivity fields will be created by DRI to represent possible small-scale distributions of that parameter. These possible random fields will be conditioned on observed values.

First, it is not clear that the measured values being referred to are relevant to the investigation of the PM CAUs.

Second, using the measured hydraulic conductivity values to provide ". . . *an uncertainty range within which the calibrated values should fall . . . "* does not necessarily provide this uncertainty range for the PM CAUs since, again, it has not been made clear, which, if any, of the measured hydraulic conductivity values are specific to the PM CAUs.

The overuse of ". . . calibrated values . . . " of hydraulic conductivity does not actually elucidate conditions in and on the boundaries of the PM CAUs and is

not an acceptable substitute for the direct measurement of values of hydraulic conductivity in and on the boundaries of the PM CAUs.

<u>Specific Comment No. 3:</u> Groundwater Flow Along Fractures and Structural Features

The primary Groundwater flow path in the Pahute Mesa area is considered to be along fractures and other geologic structural features. On p. 33 of the document the statement is made that *"In fractured media, the effective porosity may be approximated by the fracture porosity because groundwater flows mostly through the fracture openings".* The CAIP-PMR1 fails to address this in the conceptual model and fails to discuss how the groundwater flow model will handle flow in fractures. The discussion on p. 179 of the document given under the heading "**Effective Porosity**" suggests that fracture porosity will be treated as if it were the porosity of a somehow equivalent porous medium. This approach is not useful to the elucidation of conditions in and on the boundaries of the PM CAUs.

NDEP recognizes that dealing with flow in fractures (fracture flow) in a numerical model that is designed to simulate flow in porous media (porous flow) is difficult, however, since fracture flow is a key factor for the Pahute Mesa groundwater flow, it will have to be addressed.

<u>Specific Comment No. 4:</u> CAU-Specific Measurements of Dispersivity Needed

On p. 34 of the document the statement is made that "*No site-specific investigations on dispersion have previously been conducted at Pahute Mesa, however, longitudinal dispersivity values were estimated from the three tracer tests conducted within or near the NTS (Borg et al., 1976; Neuman, 1990; Daniels and Thompson, 1984)".* On p. 109 of the document is a discussion of a study of " . . . *dispersivity observations from 59 different field sites, domestic*

and abroad." Attempts to use non-CAU-specific data in place of CAU-specific data for a CAU-specific model, particularly when the needed data do not exist for the CAU in question, are not acceptable. PM CAU-specific measured dispersivities, which are likely different for each pollutant and contaminant, are needed.

Specific Comment No. 5: **Data Insufficient to Estimate Dispersivity via "Calibration of a Transport Model"**

On p. 109 of the document, the statement is made that "*Estimates of dispersivity may be obtained . . . through calibration of a transport model".* This statement assumes that the actual transport of pollutants and contaminants in the subsurface has been adequately characterized. This statement is not supported by the CAIP-PMR1. It, however, points out the need to characterize the current locations of the pollutant/contaminant plume(s) in the subsurface.

Specific Comment No. 6: **CAU-Specific Measurements of Matrix Diffusion Needed**

On p. 34 of the document, the statement is made that "*No site-specific investigations have been conducted to study matrix diffusion in Pahute Mesa, however, a study on matrix diffusion in the tuffs of the Yucca Mountain area has been conducted by Triay et al. (1993). Their results may be used for the similar rock types of Pahute Mesa".* The discussion in Subsection **3.4.8.3 Matrix Diffusion Coefficient** refers to studies of matrix diffusion coefficient that do not pertain to the PM CAUs. As stated above, attempts to use non-CAU-specific data in place of CAU-specific data for a CAU-specific model, particularly when the needed data do not exist for the CAU in question, are not acceptable.

Specific Comment No. 7: **A Single Value of Matrix Diffusion Coefficient from a Single Location on Pahute Mesa Insufficient to Characterize All of Pahute Mesa**

On p. 180 of the document, the statements are made that "*Matrix diffusion coefficient estimates will be available from the BULLION tracer experiment described in Section 6.0. This will be the best data available for Pahute Mesa. Other measurements of the diffusion coefficient are available from the literature and will be evaluated to assess the range of uncertainty in the matrix diffusion coefficient values.*"

First, the relevance of " . . . *measurement of the diffusion coefficient . . . available from the literature . . .* " to needed values in and on the boundaries of the PM CAUs has not been demonstrated. Actual PM CAU-specific measurements of diffusion coefficient are needed for use in the modeling effort.

Second, "*Matrix diffusion coefficient estimates . . . from the BULLION tracer experiment . . .* " have not been shown to be representative of other locations on Pahute Mesa. Thus, again, apparently extensive measurements of matrix diffusion coefficients in and on the boundaries of the PM CAUs are needed, and as discussed above, plans for their measurement as addenda to this CAIP are needed.

Specific Comment No. 8: **CAU-Specific Measurements of Distribution Coefficients and Porosities Needed**

On p. 35 of the document under the heading **Distribution Coefficients** it is indicated that no PM CAU-specific distribution coefficient values are available. A similar discussion occurred in Subpart **3.4.8.4 Distribution**

Coefficients as well. Subsection **3.4.8.1 Porosity** discusses data that for the most part are not on point as regards porosities in and on the boundaries of the PM CAUs. Both these items appear to be PM CAU-specific data deficiencies to be remedied.

Specific Comment No. 9: **Insufficient Knowledge of Pollutants and Contaminants in the Groundwaters Beneath the PM CAUs**

Subsection **3.5.1 Contaminants** does not give either contaminant concentrations or locations in and on the boundaries of the PM CAUs.

In fact, the title of **Table 3-40**, **Preliminary List of Potential Radioactive Contaminants for UGTA**, appears to indicate that specific knowledge of actual contaminants in the Groundwaters beneath the PM CAUs is lacking. Data collection proposals for removing this deficiency of a lack of specific information regarding the species, their respective concentrations, and rates of movement in the Groundwaters beneath the PM CAUs appear to be needed.

Specific Comment No. 10: **CAU-Specific Data Needed, Non-CAU-Specific Data Irrelevant to Development of CAU-Specific Conceptual Model**

Page 67 of the document contains the beginning of Subsection **3.4.5.2.1 Hydrostratigraphy**. Unfortunately, as noted above, the investigation area is more than three thousand square miles larger than the actual area to be investigated, namely CAUs 101 and 102. The discussion is generalized and not specific to CAUs 101 and 102. Data acquired miles away from the boundaries of the PM CAUs do not have much relevance at the CAU scale.

On p. 166 of the document the statement is made that " . . . *non-CAU specific data may be included in the development of the conceptual model, particularly to provide additional constraints on parameter uncertainty."* This is acceptable, however, if additional data are required to produce a credible conceptual model of the PM CAUs, those PM CAU-specific data will have to be collected.

Specific Comment No. 11: PM CAU-Specific Measurements of Storage Coefficient Required

On p. 170, the statements are made that *" On Pahute Mesa, the BULLION experiment provided one of the few good estimates of storage coefficient for saturated volcanic units (IT, 1998b). Several aquifer tests in carbonate rocks away from the NTS also provided good storage coefficient values (Bunch and Harrill, 1984)."*

First, relevance between the storage coefficient results of " . . . *aquifer tests in carbonate rocks away from the NTS . . . "* to the PM CAUs has not been demonstrated.

Second, with regard to the BULLION experiment, provision of " . . . *one of the few good estimates of storage coefficient for saturated volcanic units . . . "* may be of value near the BULLION event, but the relevance of the BULLION storage coefficient to storage coefficients, as yet unmeasured, at other locations in the PM CAUs has not been demonstrated. This relevance can be only be demonstrated by actual direct field measurements of storage coefficient values in and on the boundaries of the PM CAUs.

Specific Comment No. 12: Modeling Activities Subject to Interim Review and Approval by NDEP

The Subsections on Model Setup, Calibration, etc. discusses the model setup, calibration, etc. in general terms. NDEP will review data reduction and modeling work in progress and provide comments and technical guidance as appropriate.

An example of possible needed technical guidance is the following. On p. 176 of the document the statement is made that "*The groundwater flow model generates the hydraulic head field from which the specific discharge vectors are determined*". The specific discharge vectors can only be determined from a "*hydraulic head field*" if the hydraulic conductivity tensor is known at all points of the model area for which the specific discharge vectors are to be "*determined*".

It is essential to use directly measured PM CAU-specific values of hydraulic conductivity to characterize conditions in and on the boundaries of the PM CAUs. This will avoid the circular approach that would result from "backing out" values of hydraulic conductivity from a combination of "known" or assumed values of hydraulic head and "known" or assumed values of specific discharge and then stating that the " . . . *specific discharge vectors* . . . " would be determined from the " . . . *hydraulic head field* . . . "

A second example of possible needed technical guidance is the following. On p. 177 of the document the statement is made that "*Later, a classified dataset, based on information from individual tests will be used to calculate the final location of the contaminant boundary.*" It appears, that since predictions of the transport of pollutants and contaminants in the subsurface are needed for eventual model validation prior to predictions of the " . . . *final*

location of the contaminant boundary . . . ," that use of the classified dataset will be required for validation.

A third example of possible needed technical guidance is the following. On p. 177 of the document the statements are made that "*The spatial distribution of contaminants will be integrated in the CAU model to preserve total mass. The release rate from rubble zone and cavity will be summarized in terms of a total mass flux, again to preserve the total mass exiting the cavity and chimney. This contaminant mass flux will serve as the source term for the transport simulations."*

No mention is made here of the successive daughter products in the radionuclide portion of the pollutant/contaminant mass flux. It is necessary that these be characterized since distribution coefficients, for example, are species-dependent, and mass flux alone is an inadequate descriptor of pollutants and contaminants in groundwater and hence an inadequate source term for transport simulations. Note in this connection that choosing distribution coefficient values from " . . . published ranges . . . " (statement on p. 179 of the document) is inadequate and measured values for the specific species of interest and for the PM CAUs are required.

<u>Specific Comment No. 13:</u> Use of the Median of the Monte Carlo Realizations

On p. 193 the statement is made that "*The predicted contaminant boundary will be the median of the Monte Carlo realizations calculated during the uncertainty analysis. As such the boundary does not represent a specific prediction, but is instead is an expected value . . . "*

It is unclear why the median, or middle of the distribution of contaminant boundary realizations (middle in the sense of the area under the distribution less than the median being equal to the area larger than the median) rather

than the mode, or most probable value of the distribution is being used as the indicator of stochastic modeling results-i.e. the distribution of realizations. Justification of this choice must be demonstrated.